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HERPETOLOGICA

A JOURNAL DEVOTED TO THE STUDY OF REPTILES AND AMPHIBIANS

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A NEW SUBSPECIES OF THE FOX SNAKE, *ELAPHE VULPINA* BAIRD AND GIRARD

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Zoological Society of Philadelphia

The peculiar distribution and marked habitat preferences of *Elaphe vulpina* in the eastern part of its range have interested me for several years. In Ohio, where I have done considerable collecting, this snake apparently is restricted to the extensive marshes (and their immediate environs) which border the southwestern shore of Lake Erie. In Ontario and the southern peninsula of Michigan there is a similar hugging of Great Lakes shores and the same predilection for marshes. In the western part of its range, however, this serpent occupies a variety of habitats including woods, stream valleys, prairies, farm lands, and the dune country rimming portions of Lake Michigan. Its distribution is more or less general over a considerable portion of the Central Lowland Province.

Recently I have examined 221 fox snakes representing a wide variety of localities. From studies made upon these it is evident that specimens from eastern localities differ from typical *vulpina* not only in habitat, but also in pattern, and that an eastern race is distinguishable from a western one.

The name *vulpina* (type locality Racine, Wisconsin) can be restricted to the western race, but for the eastern race a new name must be found. In searching for such I have investigated *Coluber ovivorus* Linnaeus (1758, 223) which I find unidentifiable, and *Elaphis rubriceps* Duméril and Bibron (1854, 270). The unique type of the latter, the exact origin of which is not known although "il est de l'Amérique du Nord d'ou il a été rapporté par M. de Castelnau," no longer is extant according to F.

Angel, of the Paris Museum, who kindly endeavored to locate the specimen for me. Castelnau's biography (Le Grande Encyclopédie, IX, 741) mentions much of his travels in South America but nothing of visits to North America. The description of *rubriceps* agrees rather closely with *vulpina*, but it is not possible to determine to which of the two races of *vulpina* the name *rubriceps* might be applied. For the eastern race, therefore, I propose the name:

Elaphe vulpina gloydi, subsp. nov.

EASTERN FOX SNAKE

Plate I, Figures 1 and 2.

Diagnosis: A large snake, similar in pattern and scutellation to *Elaphe vulpina vulpina* Baird and Girard, but differing chiefly in the smaller number and larger size of its dorsal body blotches. These average 34.5 as compared with 40.9 in *vulpina*, and anteriorly they are 4, 5, or 6 scales in length, as compared with 3 or 4 (and more rarely 5) scales in length in *vulpina*. The number of tail blotches also is less in *gloydi*. Specimens of *gloydi* attain a somewhat greater maximum length and appear to be more robust in form.

Type Specimen: Academy of Natural Sciences of Philadelphia, Number 21650 (original number 1086), adult female collected on Little Cedar Point, Jerusalem Township, Lucas County, Ohio, May 27, 1939, by Robert H. Mattlin. *Allotype:* Academy of Natural Sciences, Number 21651 (original number 1088), adult male, same collector and locality, August 5, 1939. *Paratypes:* Academy of Natural Sciences of Philadelphia, Numbers 21652-21661, Chicago Academy of Sciences, Number 6935, and Iowa State College, Number 7.

Description of type specimen: Rostral wider than high, somewhat notched below for the passage of the tongue. Nasal divided, the nostril centered between the anterior and posterior halves. Loreal longer than high, sub-trapezoidal in shape. One preocular, two postoculars. Temporals, two in the first row, four in the second, and five in the third. Internasals two, each about one-third the size of the corresponding prefrontal. Frontal about as long as wide, roughly bell-shaped, its base directed forward. Supraoculars about twice as long as wide. Parietals one and a half times as long as frontal, somewhat rugose and slightly irregular posteriorly. Supralabials 8, the seventh largest and the fourth and fifth entering the orbit. Infralabials 11 on the left and 12 on the

PLATE I

Fig. 1. *Elaphe vulpina gloydi*, new subspecies. Allotype, ANSP No. 21651, Little Cedar Point, Jerusalem Township, Lucas County, Ohio. Photograph by Mark Mooney, Jr.

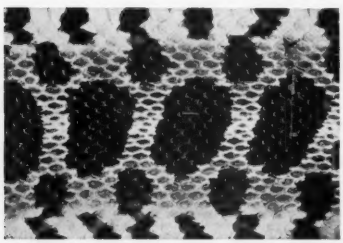


Fig. 2. Skin pattern at midbody of *Elaphe vulpina gloydi*, allotype, showing wide blotches as compared to the more narrow ones of *vulpina*. Photograph by Mark Mooney, Jr.

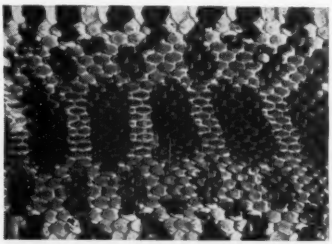


Fig. 3. Skin pattern at midbody of *Elaphe vulpina vulpina* Baird and Girard. ISC No. 6, 1 mile southeast of Sandyville, Warren County, Iowa. Photograph by Mark Mooney, Jr.

right, the sixth largest on each side, and the first on each side meeting its partner directly posterior to the mental. A large pair of chin shields are contiguous along the median line; behind each one of these is a smaller shield separated from its partner by three rows of small scales.

Scale rows 25-27-25-23-21, the increase taking place by the addition of a seventh row of scales beginning on the right side of the body opposite the 60th ventral and, on the left, opposite the 63rd. This row is dropped on the left side of the body opposite the 102nd ventral and on the right opposite the 104th. The reduction from 25 to 23 rows is accomplished by the loss of the sixth row of scales at a point opposite the 122nd ventral; the reduction from 23 to 21 by the loss of the sixth row (opposite ventral 149 on the left and 151 on the right). Anteriorly the first 8 rows of scales are smooth, and posteriorly the first 5; the others are weakly keeled. Dorsal scales with two apical pits.

Ventrals 205; anal plate divided. Subcaudals 56, in two rows; tail terminated by a short, stout tip.

Dorsal ground color of fresh specimen (in alcohol) Ochraceous Buff, each scale stippled over all but its perimeter with brown (Bister). Ground color fading to Mustard Yellow on lower sides of body; stippling on scales also lighter than on back. Ground color toward tip of tail Ochraceous Orange. Dorsal blotches Blackish Brown (2) narrowly edged with black. Anterior blotches 5 or 6 scales long by 13 to 15 scales wide; posterior blotches 3 or 4 scales long by 10 to 12 scales wide. Dorsal blotches 36 in number, some of them partially split transversely by areas of ground color. A row of similar but smaller blotches along each side of body, these alternating in position with the blotches of the dorsal series. Tail blotches 12.

Top of head Hazel, a dark (Dusky Brown) band across the head in front of the eyes, another extending downward from the eye and another from the eye obliquely backward to the angle of the jaws. Parietals and posterior portion of frontal mottled with Dusky Brown. Lower labials and lower half of upper labials Light Buff; some of the sutures between them outlined with Dusky Brown. Upper labials changing to Hazel on their upper halves. Chin and throat Light Buff. Hazel of head changing to Mars Orange on posterior temporals. First dorsal blotch with two forward extensions which fade anteriorly and just barely reach the parietals. Belly Citron Yellow with four rows of large black checks, the outer row on each side extending upward onto the first 2 or 3 scale rows and in most cases, alternating in position with the lateral

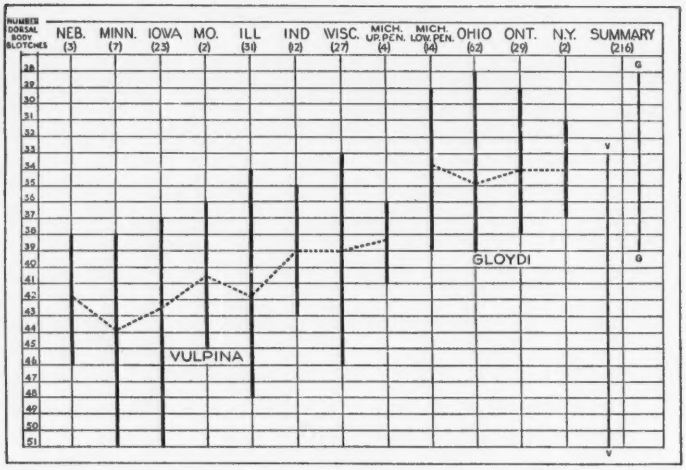
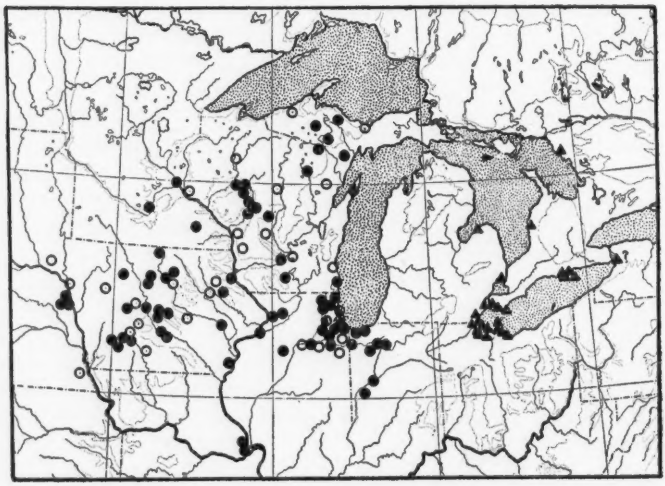


Fig. 1. Variation in the number of dorsal blotches in the subspecies of *Elaphe vulpina*. The heavy vertical lines show the range of variation in each state or division thereof; the dotted lines connect the averages. The small numbers in parentheses give the number of specimens from each area.



Map 1. Distribution of the subspecies of *Elaphe vulpina*. Circles indicate locality records for *Elaphe vulpina vulpina* and triangles for *Elaphe vulpina gloydi*.

blotches, but sometimes uniting with them. Length 1167 mm., tail 157 mm., tail/length 13.5%. Capitalized color names are those of Ridgway's "Color Standards and Nomenclature."

One of the paratypes (CA 6935) has the prefrontals split longitudinally so that there are actually four prefrontals all subequal in size. Another, a juvenile (ANSP 21656) has the dorsal ground color Snuff Brown and the blotches Seal Brown. Black greatly predominates on the belly, and the lighter areas below, including the chin, are suffused with brown.

Range: Elaphe vulpina gloydi occurs in suitable localities along and near the shores of Lakes Huron and Erie, from Georgian and Saginaw Bays southward to north central Ohio, and eastward along the northern shore of Lake Erie to Long Point and perhaps Buffalo (Map 1). Locality records are as follows:

MICHIGAN: *Huron Co.*: Sand Point (MCZ 29036; UMMZ 37625-30, 37745). *Monroe Co.*: (UMMZ 44629). *St. Clair Co.*: Harsons Isle (UMMZ 36050); Pearl Beach (UMMZ 35851). *Wayne Co.*: Grosse Isle (UMMZ 42495; USNM 1570); below Trenton (UMMZ 61721).

NEW YORK: "Near Buffalo" (ANSP 3779-80). It is quite possible that these specimens may have come from Ontario rather than from New York.

OHIO: (USNM 83450-1). *Erie Co.*: Sandusky (AMNH 3502; Baylor 1842); Margaretta Twp. (AMNH 49901). *Lucas Co.*: Little Cedar Point, Jerusalem Twp. (ANSP 21650-21661; CA 6935; ISC 7). Also all localities listed on page 62 of the "Reptiles of Ohio" (Conant, 1938).

ONTARIO: *Bruce S.*: Lucknow (USNM 56610). *Essex S.*: Auld (ROMZ 2186); Colchester (USNM 48540); Kingsville (ROMZ 4585-6); Point Pelee (ROMZ 1803; UMMZ 40673-4). *Norfolk*: Long Point (ROMZ 2096-2100, 2148, 2666, 3672, 3677, 3687, 5469); Port Rowan (CM 16785); St. Williams (ROMZ 2675); Turkey Point (ROMZ 3698, 3802). *Parry Sound*: Point Au Baril (ROMZ 5187, 5196, 5470-1).

Through the courtesy of E. R. Dunn and Gilbert Congdon Wood, I have seen the specimen of *Elaphe vulpina* from Wenham, Massachusetts (BSNH 1209) which was received by the Museum of Comparative Zoology in 1861 from James Bartlett and first reported by Allen (1868). This snake has 43 body blotches, a number that definitely places it in *vulpina* rather than in *gloydi*, which latter might be expected in Massachusetts *if* the range extended that far to the east. Brown (1902) commented on this specimen, but not having seen it he considered it to be misidentified. I find the identification to be correct but undoubtedly the locality is in error.

Variation: The chief diagnostic characteristic of the two subspecies of *vulpina* is in the number of dorsal blotches, counting from the head to a point directly above the anus. The results of such counts, made on 216 specimens, are indicated in graphic form (Fig. 1). In *gloydi* the

number varies from 28 to 39, with an average of 34.5; in *vulpina* from 33 to 51, with an average of 40.9. The two forms overlap between 33 and 39, or over 29.1 percent of the total range of numbers. The frequency distribution of dorsal blotch counts is shown in Table I in which it may be seen that 97, or 90.7% of the specimens of *gloydi* have 37 blotches or less, while 91, or 83.5% of the specimens of *vulpina* have 38 blotches or more. The peak in each subspecies closely approximates the average. Of the five specimens of *vulpina* with the unusually low counts of 33 and 34, three are from a single locality well within the range of *vulpina* (Worden Twp., Clark Co., Wisconsin) and two of these are newly hatched juveniles. Ten other specimens from the same and adjacent counties have dorsal blotch counts ranging from 37 to 43 and averaging 39.3. Similar departures from the average in individual specimens or localities frequently occur in other closely related subspecies of snakes.

Correlated with the difference in number of dorsal blotches is the size of the blotches themselves. These, in general, measure 4, 5 or 6 scales in length in *gloydi,* while in *vulpina,* with its greater number of blotches, individual ones are reduced accordingly so that they usually are only 3 or 4 (sometimes 5) scales in width (Plate 1, Figs. 2-3).

The number of blotches on the tail also is lower in *gloydi,* ranging from 9 to 16, average 13.3 in males, and from 9 to 14, average 11.4 in females as compared with 10 to 19, average 14.4 in males, and 9 to 19, average 12.4 in females of *vulpina.*

It is interesting to note that Baird and Girard (1853, 75-6) indicated the difference in number of dorsal and tail blotches in the two subspecies of *vulpina,* even though they were not aware that two races existed. Of their two specimens, one from Racine, Wisconsin, had a total of 60 blotches, of which 44 were anterior to the anus; in the other, from Grosse Isle, Michigan (USNM 1570-identified by me as *gloydi)* there were 45, of which 13 were on the tail. Their description of the species, however, is obviously based upon the Racine specimen.

The maximum length of *gloydi* is greater than that of *vulpina.* Among specimens of *gloydi* which were studied, the largest male (Norfolk Co., Ontario) measures 1648 mm. and the largest female (Huron Co., Michigan) measures 1452 mm. The corresponding figures for the largest *vulpina* are male (Marquette Co., Michigan) 1540 mm., and female (Langlade Co., Wisconsin) 1348 mm. The ten largest males of *gloydi* average 1485.3 mm. as against 1351.5 mm. in the ten largest males of

vulpina. In females the figures are 1322.1 and 1198.1 mm. respectively.

Large adults of *gloydi* appear to be more robust than large adults of *vulpina*. This is only a "to the eye" difference, however, for the difficulties of measuring the body widths of either live or preserved specimens with any degree of accuracy prevents the presentation of comparative figures.

Most of the scale counts average slightly higher in *gloydi* than in *vulpina*. Thus, males have 190 to 212 (av. 200.2) ventrals and females 202 to 215 (av. 207.9) in *gloydi;* while corresponding figures are 190 to 210 (av. 199.7) in males and 198 to 216 (av. 206.6) in females of *vulpina*. Males of *gloydi* have 54 to 71 (av. 65.2) subcaudals and females 45 to 60 (av. 56.8), as compared with 52 to 68 (av. 62.8) and 51 to 59 (av. 55.1), respectively, in *vulpina*.

The upper labials are 8 in 95.5% and 7 in 4.5% of the counts in *gloydi* males, and 8 in 88.2%, 7 in 9.8% and 9 in 2% of *gloydi* females; upper labials in *vulpina* males are 8 in 94%, 9 in 4.3% and 7 in 1.7%, and in *vulpina* females 8 in 91.7%, 7 in 6.2% and 9 in 2.1%. The lower labials are 11 in 71.3%, 10 in 14.8%, 12 in 9.3% and 9 in 4.6% of the counts in *gloydi* males, and 11 in 74%, 10 in 16.3%, 9 in 5.8% and 12 in 3.8% in *gloydi* females; lower labials are 11 in 67.8%, 10 in 14.8%, 12 in 11.3%, 9 in 5.2% and 13 in .9% of *vulpina* males, and 11 in 72%, 10 in 19.4%, 12 in 5.4%, 9 in 2.2% and 13 in 1.1% of *vulpina* females. Most frequently, in both upper and lower labials the counts are the same on each side of the head, but various combinations are found. In calculating the percentages above, two counts (one left and one right) were used for each snake.

The maximum number of scale rows is somewhat greater in *vulpina*, being 25 in 52.8% of the specimens and 27 in 47.2%. The corresponding figures in *gloydi* are 56.6% and 42.5%. One specimen of *gloydi* from the type locality (ANSP 21658) has a maximum of 23 rows.

The figures obtained by dividing the tail length by the total length of each specimen average almost the same in both subspecies. Thus, in *gloydi* males the percentages are 13.6 to 18.9 (av. 16.3) and in females 12.1 to 17 (av. 14.1); in *vulpina* males the percentages are 13.3 to 18.3 (av. 16.1), and in females 11.7 to 15.8 (av. 13.9).

Discussion: As Schmidt (1938, 402) has suggested, *Elaphe vulpina* probably invaded the northern and eastern portions of its range after the retreat of the glaciers. Its range toward the east is now discontinuous and the population in that region can be considered as relict and restricted

to specialized habitats paralleling shores of the Great Lakes. Isolation or selective environmental factors (or both) have resulted in relatively slight differences in scutellation and size and a significant difference in the number of dorsal blotches. An intergrading population is lacking but the considerable overlapping of the two forms in almost all characteristics is too great to admit the consideration of *gloydi* and *vulpina* as distinct species.

Elaphe vulpina vulpina Baird and Girard
WESTERN FOX SNAKE
Plate I, Fig. 3.

Diagnosis: A large *Elaphe* with a reddish or reddish-brown head. Pattern consisting of a medium series of large chocolate or black blotches 33 to 51 (av. 40.9) in number and flanked on each side of body by two alternating rows of smaller blotches. Ground color above yellowish or light brown; belly yellow, checked with black. Distinguished from *E. v. gloydi* by the greater number and smaller size of the dorsal blotches (av. 34.5 in *gloydi*); from *E. o. obsoleta* by its different coloration and smaller number of ventrals (216 or less in *vulpina;* 221 or more in *obsoleta*), and from *E. laeta* by the lack of forward extensions from the first dorsal blotch which traverse the parietals and unite on the frontal. Baird and Girard's type, formerly in the collection of the Smithsonian Institution, apparently cannot now be found in the National Museum. It therefore appears advisable to designate as neotype, USNM 9969, Racine, Wisconsin, P. R. Hoy, collector. In this specimen the scale rows are 25-23-21, ventrals 202, subcaudals 65, upper labials 8, lower labials 11 on left - 12 on right, oculars 1-2, temporals 2-3, dorsal blotches 46, tail blotches 17, length 1242 mm., tail 183 mm., tail/length 14.9%.

Range: Northwestern Indiana and the northern peninsula of Michigan southwestward to eastern Missouri, eastern Nebraska and southeastern South Dakota (Map 1).

Locality records are:

ILLINOIS: (AMNH 44509; ANSP 16968-9; MCZ 5574). *Bureau Co.*: Milo (USNM 17955). *Cook Co.*: Argo (FMNH 21739); Bloom Twp. (FMNH 23545); Chicago (CA 945, 2644); Chicago Ridge (FMNH 8279); Evanston (CA 65); Hazelcrest (FMNH 17843); Homewood (FMNH 15990); Lemont (FMNH 27275); Palos Park (Schmidt & Necker, 1935, 69); West Northfield (UMMZ 3745; USNM 1620). *DuPage Co.*: Naperville (FMNH 22735). *Grundy Co.*: Pequot (Necker, 1939, 7). *Kankakee Co.*: Aroma Park (Necker, 1939, 7). *Lake Co.*: Barrington (FMNH 25295); Beach (CA 1490, 2503; FMNH 19171); Volo, Sayer Bog (Necker, 1939, 7). *LaSalle Co.*: 4 mi. E of LaSalle (Burt & Hoyle, 1934, 208); 3 mi. E of Marseilles (USNM 83962); 4 mi. E of Ottawa (UMMZ

71658). *McHenry Co.*: McHenry (CA 1491). *Ogle Co.*: Pine State Park, Polo (CA 1594, 2036). *Rock Island Co.*: Rock Island (USNM 2324). *Whiteside Co.*: Morrison (FMNH 14805). *Will Co.*: 4 mi. N of Beecher (Burt & Hoyle, 1934, 208); Custer Park (CA 1595); DuPage Twp. (FMNH 25223); Joliet (FMNH 2461); Romeo (Necker, 1939, 7); Wheatland Twp. (FMNH 3367).

INDIANA: *Fountain Co.*: 14 mi. SE of Attica (UL 2084). *Lake Co.*: Illinoi (FMNH 3354); Liverpool (FMNH 2675, 2697). *LaPorte Co.*: 2 mi. SW of Westville (ISC 14). *Marshall Co.*: Culver (AMNH 25547); Lake Maxinkuckee (USNM 33537, 33546). *Porter Co.*: Dune Acres (FMNH 3274); Dunes W of Porter (FMNH 3412); Porter (Necker, 1939, 7); Wilson (FMNH 3062). *Pulaski Co.*: Near Medaryville (CM 9744). *Starke Co.*: (MCZ 14100); Road to Bass Lake (CAS 12889). *Tippecanoe Co.*: Lafayette (USNM 23941). I cannot admit the Indiana records of Hay (1892, 499), for he obviously confused *Elaphe o. obsoleta* with *E. vulpina*. The maximum number of both ventrals and subcaudals, as given by him, considerably exceeds the limits for *vulpina*.

IOWA: *Adair Co.*: 6 mi. S of Adair (ISC 15); 10 mi. N of Greenfield (ISC 3). *Boone Co.*: 4 mi. NW of Boone (ISC 13). *Buchanan Co.*: 2 mi. E of Jesup (Burt & Hoyle, 1934, 208). *Cass Co.*: Near Atlantic (ISC 9, 16); 2 mi. N of Lyman (ISC 1). *Clayton Co.*: Guttenberg (ISC 2). *Dallas Co.*: Minburn (Guthrie, 1926, 178). *Delaware Co.*: Manchester (FMNH 6303). *Des Moines Co.*: Burlington (MCZ 39). *Fayette Co.*: 9 mi. E of Oelwein (Scott, 1938, 531). *Franklin Co.*: 1 mi. NW of Burdette (KU 19199); 8 mi. E of Hampton (ISC 5). *Greene Co.*: 4 mi. W of Jefferson (ISC 8). *Guthrie Co.*: Casey (Scott, 1938, 531). *Hamilton Co.*: Little Wall Lake (ISC 10, 11); Webster City (USNM 9613). *Hardin Co.*: Iowa Falls (Ruthven, 1919, 2). *Johnson Co.*: Iowa City (CM 16786). *Pocahontas Co.*: (UMMZ 60173). *Polk Co.*: (Guthrie, 1926, 178; Ft. Des Moines (USNM 60045). *Poweshiek Co.*: Grinnell (Ruthven, 1912, 207). *Sac Co.*: (Guthrie, 1926, 178). *Story Co.*: Ames (Guthrie, 1926, 178); 2 mi. S of Huxley (ISC 18); 3 mi. S of Nevada (ISC 17). *Union Co.*: 2 mi. E of Thayer (Burt & Hoyle, 1934, 208). *Warren Co.*: (Guthrie, 1926, 178); 2 mi. SE of Sandyville (ISC 6, 12). *Webster Co.*: 1 mi. N of Boone Co. line on U. S. Route 169 (Scott, 1938, 531). *Winnebago Co.*: 5 mi. E of Forest City (UMMZ 79183). *Woodbury Co.*: Sioux City (Ruthven, 1919, 2). *Wright Co.*: 8 mi. S of Solberg (ISC 4). Dr. Reeve M. Bailey has furnished me with the detailed localities for the published county records of Guthrie and Scott.

KENTUCKY: In the complete absence of Kentucky specimens I cannot accept the statement of Funkhouser (1925, 117) that the fox snake is "fairly common throughout the state." It is possible that he has confused *vulpina* with brownish specimens of *Elaphe obsoleta*.

MICHIGAN: *Alger Co.*: (Ruthven, Thompson & Gaige, 1928, 94). *Dickinson Co.*: (UMMZ 82905). *Iron Co.*: Deer River (UMMZ 77707). *Marquette Co.*: (UMMZ 63418). *Menominee Co.*: (UMMZ 63423). *Ontonagon Co.*: (Ruthven, Thompson & Gaige, 1928, 94).

MINNESOTA: (ANSP 3781; CA 66). *Hennepin Co.*: Ft. Snelling (AMNH 3501; USNM 1727-8). *Nicollet Co.*: St. Peter (KU 2091). *Olmstead Co.*: (USNM 56608).

MISSOURI: *Lincoln Co.*: Old Monroe (DAB 1232). *St. Charles Co.*: (USNM 56609)

NEBRASKA: 75 mi. N of Council Bluffs (MCZ 49). *Burt Co.*: 3 mi. N of Decatur (GEH 301); 3 mi. NE Lyons (UMMZ 71657; USNM 83957). *Nemaha Co.*: (Taylor, 1892, 341).

SOUTH DAKOTA: Southeastern corner of the state (Over, 1923, 24).

WISCONSIN: *Buffalo Co.*: (Pope and Dickinson, 1928, 55). *Chippewa Co.*: Stanley (AMNH 14551, 20598). *Clark Co.*: Dewhurst Twp. (FMNH 14547); Foster Twp. (FMNH 13202); Hewett Twp. (FMNH 13201); Worden Twp.

(FMNH 8078, 8283-5). *Columbia Co.*: (Pope and Dickinson, 1928, 55). *Door Co.*: (TPH). *Florence Co.*: Florence (FMNH 3333). *Green Co.*: Monticello (UMMZ 64762). *Jackson Co.*: Bear Bluff (FMNH 21745); Black River (UMMZ 64760); Dickey Creek (UMMZ 64761). *Juneau Co.*: (Pope and Dickinson, 1928, 55). *Langlade Co.*: Mosquito Lake, Ainsworth Twp. (CA 3852-8). *Marathon Co.*: (Pope and Dickinson, 1928, 55). *Milwaukee Co.*: (Pope and Dickinson, 1928, 55). *Oconto Co.*: (Pope and Dickinson, 1928, 55). *Pierce Co.*: (Pope and Dickinson, 1928, 55). *Racine Co.*: Racine (MCZ 347; USNM 7269, 9969). *Rusk Co.*: (Pope and Dickinson, 1928, 55). *Sauk Co.*: Merrimac (CA 6933). *Vernon Co.*: (Pope and Dickinson, 1928, 55). *Wood Co.*: Babcock (FMNH 15972); Yellow River (UMMZ 64759).

Common names: In the various parts of their ranges snakes of both subspecies of *vulpina* are known as "pine snake," "spotted adder," "timber snake," "hardwood rattler," "copperhead," etc. and the name "fox snake," apparently is used only by herpetologists and readers of their works. According to some authorities this name originated because of the fox-like odor of the snakes' musk gland secretions. After several years of experience with foxes and fox snakes, both in the field and in captivity, I have failed to detect any similarity in odor between them. In fact these serpents seem rarely to excrete musk when captured.

I might suggest that Baird and Girard *(loc. cit.)* applied *vulpina* as a patronymic in honor of the Reverend Charles Fox, the collector of one of the specimens they mentioned. If this be true then they translated his name instead of Latinizing it.

ACKNOWLEDGEMENTS

For lending specimens from their respective institutions I am indebted to Mrs. Helen T. Gaige, University of Michigan, Museum of Zoology (UMMZ); Dr. Doris M. Cochran, United States National Museum (USNM); Karl P. Schmidt, Field Museum of Natural History (FMNH); Dr. Howard K. Gloyd, Chicago Academy of Sciences (CA); E. B. S. Logier, Royal Ontario Museum of Zoology (ROMZ); Arthur Loveridge, Museum of Comparative Zoology (MCZ); M. Graham Netting, Carnegie Museum (CM); Dr. Reeve M. Bailey, Department of Zoology, Iowa State College (ISC); Dr. William M. Clay, University of Louisville (UL); Dr. George E. Hudson, State College of Washington (GEH); Charles M. Bogert, American Museum of Natural History (AMNH). I also have examined specimens in the collection of the Academy of Natural Sciences of Philadelphia (ANSP).

Through the courtesy of Dr. Gloyd I have been supplied with considerable data concerning specimens in other collections. These include material belonging to the University of Kansas (KU); Baylor University Museum (Baylor); Dorothy A. Boyer (DAB); California Academy of Sciences (CAS) and T. P. Haines (TPH).

Many of the persons enumerated above have been most helpful in supplying information and offering suggestions during the preparation of this paper. So also have Dr. E. R. Dunn, Dr. Francis Harper, Dr. Gordon L. Walls, Walter L. Necker, C. B. Perkins, Chapman Grant, and the late Dr. Frank N. Blanchard.

To Edmond Malnate, Laird Starr, Alexander Downs, Jr., and Miss Justine Rawle, all of Philadelphia, I am deeply indebted for considerable assistance in recording scale counts and for other clerical help.

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AUTHOR'S NOTE

Since completing the preparation of this paper, I have seen two additional specimens from Missouri; viz.: *St. Charles Co.;* 6 miles north of St. Peters (CA 8532) and 4 miles north of St. Peters (CA 8606). These snakes, both males, have 41 and 39 dorsal blotches, respectively. When these figures are added to the number of dorsal blotches on the other two Missouri specimens (p. 11) the averages become 40.3 instead of 40.5. Likewise the general averages are affected only very slightly if the scale counts and other statistics obtained from these two specimens are added to the data from other specimens of *vulpina*.

MATERNAL CARE OF EGGS BY FARANCIA

GEORGE P. MEADE
Gramercy, Louisiana

The general belief has been that oviparous snakes, with the exception of the pythons, pay little or no attention to their eggs after laying them. A few instances have been related where smaller species have accorded the eggs some protection and recent books have suggested that further study might reveal that maternal care is much more usual than is now supposed. Evidence is presented here which indicates that care of the eggs by *Farancia* may be fairly common.

In a previous article on the breeding habits of *Farancia* (Copeia, 1937: 12) it was stated that "it seemed evident to the observers that an attempt was being made by the snake to keep the eggs within the coils of her body as they were laid but whether this was for the purpose of incubating them or merely to hold them in a close group could not be determined." The writer was away on a trip at the time this clutch was laid but the eggs were removed and placed under proper conditions for incubation as per instructions. Nineteen of the twenty-eight eggs hatched eight weeks later.

During the current spring and summer (1939) a varying number of mud snakes (all *Farancia abacura reinwardtii)* were kept in an outdoor cage having a dirt floor 3′ x 6′ with wire-mesh sides and top. No mating activities were noted among these snakes. On August 10 at 8 A.M. a female was observed in one corner of the cage with 18 eggs, the egg-laying having already been completed. This specimen, which was about 52 inches long, had probably been captured in early June, but this point is not certain. The snake was surrounding the eggs in the manner described in the previous article, and it was decided to permit her to continue with the eggs as long as she showed any inclination to do so. The other snakes in the cage were removed and for protection against sun and air a large galvanized iron pan was inverted over the coiled snake and eggs with the edge of the pan raised about two inches to permit entrance and exit if desired. Frequent observations during the next six days showed that the snake's position changed slightly from time to time, the changes in general tending to pull the clutch of eggs closer together and to cover them more fully with the coils of the body, although after a few days one egg was entirely outside of the group and away from the snake.

On the morning of the sixth day the snake was found in the opposite end of the cage, and the eggs were somewhat scattered. The dirt floor of the cage, which had been quite moist at the time the eggs were laid, had begun to dry, and it was decided to remove half the eggs and incubate them artificially as they showed evidence of shrivelling. Nine eggs were measured and found to be very regular in size, the smallest being 20mm x 33mm and the largest 21mm x 35mm. The general characteristics were the same as the clutch described in the previous article--smooth, non-adherent, cylindrical with hemispherical ends. These eggs were placed in a large jar containing wet sand and covered with moist absorbent cotton.

Meanwhile the galvanized pan had been inverted over the eggs as before and the snake had crawled back under it and had formed a large irregular loop around the remaining nine eggs. The next morning the snake was again in a tight coil with the eggs closely held in a group in the center. At this time the characteristic color changes preceding moulting had begun. In order to provide moisture for the snake and for the eggs, they were covered with a moist cotton sugar sack, so arranged that the snake could crawl in and out between the sack and the ground. The use of the moist sack was continued until just before the eggs hatched.

Shedding occured a week later (August 25) the skin being found in pieces, as is characteristic with *Farancia*, at the far end of the cage, with the snake again coiled about the eggs. It seemed significant that the shedding was effected as far away from the eggs as possible, since cast skins attract ants almost immediately in this climate.

The snake appeared to be hungry the next day, raising the head and following the movement of a hand or finger, although she still coiled about the eggs. She was removed from the cage and given a small *Amphiuma* which was immediately swallowed. On being replaced in the cage she returned to the eggs after a few hours, coiling closely about them only after the sack covering and galvanized pan had been replaced.

Similar feedings occured on September 1, 4, and 15 with the snake following much the same course of action when replaced in the cage. Four times during the period described the snake left the eggs to defecate, always choosing a spot in the far end of the cage for this purpose. On September 10, exactly one month after the egg laying, the snake was again photographed to show the close coil. At this time the color changes preceding moulting were again evident, and the second shedding occurred on September 15, the skin being cast well away from the eggs

PLATE II

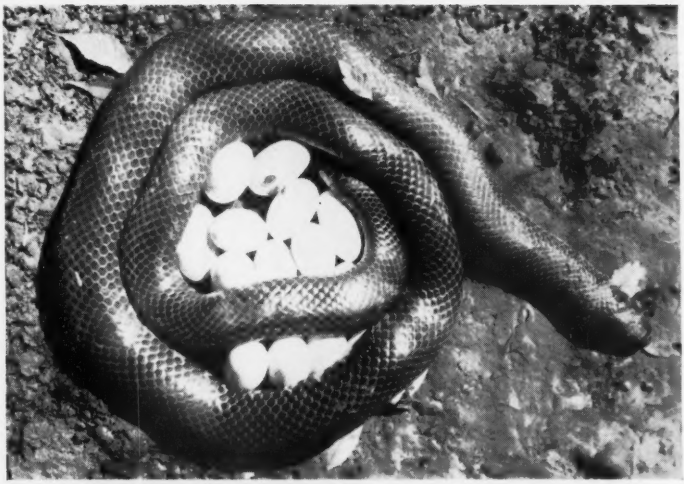

Figure 1. *Farancia* with eighteen eggs on August 10, 1939, two hours after laying.

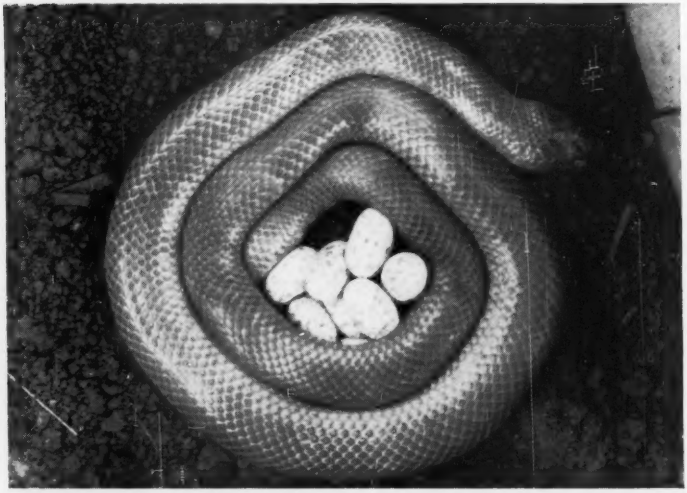

Figure 2. Same snake September 10, 1939, one month after laying, in characteristic close coil with nine eggs, the other nine having been removed for artificial incubation. Lead-grey color preceding moulting is evident.

as in the first instance. It is noteworthy that throughout the entire time that these eggs were lying on the dirt floor of the cage there was no evidence of attack by ants, which were especially prevalent this summer, nor by any other insects.

It should be emphasized that at no time during the incubating period did the snake do anything of a spectacular nature. She did not resent handling, offered no objection to being removed from the eggs, and never appeared nervous or disturbed. She did not seem anxious to return to the eggs immediately when she was away from them, but in the nine instances when she left the eggs (or was removed from them), she was always found afterwards coiled around the eggs in such a way as to suggest intentional protection.

The nine eggs which had been incubated in the moist sand all hatched on September 28, seven weeks from the laying date. The young were about 8 inches long and similar in all respects to those described in the previous article on the breeding habits of *Farancia*. Particularly noticeable were the use of the diminutive tail spine and the curling of the tail to show the bright red under-pattern.

The remaining nine eggs and the mother-snake were removed on September 29, as the cage had been flooded by a torrential rain. One of the eggs was opened and found to contain a fully formed live snake which was still attached to the egg yolk. Of the other eight eggs, one was found to be shrivelled and was discarded, the other seven being placed in the jar with moist sand in which the first group of eggs had been hatched. The writer left for his vacation that day and is indebted to Mr. Henry G. Gerstner for the following data regarding these eggs which had been guarded for seven weeks by the female: two eggs hatched on October 2nd, one on the 3rd, two on the 4th, while the last hatchling perforated the egg at 6 P. M. on October 5th to emerge at noon on the 6th. One egg did not hatch.

Further evidence of the care of eggs by *Farancia* came as a coincidence in a letter received August 15th from Mr. Phillip D. Evans of Kansas City, Missouri, who had no knowledge of the study just then being started on the clutch of eggs reported above. Thanks are due Mr. Evans for permission to quote from his letter as follows:

"A farmer in Dunklin County, Missouri, claimed to have killed a 'stinging snake' that he found under a large board near a drainage ditch, and according to the farmer the snake was coiled with a clutch of about 15 eggs. I secured some of the eggs, which hatched two weeks later.

Since you have found that the period of incubation is much longer, this would suggest that possibly this species in some cases does remain with her eggs. Of course, it may have been a coincidence, as I don't even know the sex of the snake killed, and it is quite possible that the place where the eggs were deposited was a suitable cover for snakes of this species."

A local lumber man reported to me several years ago that during his many years of experience in the nearby cypress swamps he had known of two instances of "stingarees" (as the mud snakes are called here) which were incubating or protecting eggs. In both cases the snakes were found by his workmen coiled about the eggs under rotted logs on ditch-banks well above the water level. The snakes were immediately killed but the snakes and eggs were seen soon afterward by my informant, and in one instance the young were just hatching, indicating that the mother had stayed with the eggs throughout the incubation period. Because of the many superstitions and erroneous beliefs associated with *Farancia* and also because the idea of snakes incubating their eggs seemed contrary to established facts, this report was not considered of importance at that time, but in view of the other evidence here given it may have corroborative value.

NATRIX RIGIDA SAY IN VIRGINIA

NEIL D. RICHMOND
Shackelford Farms, Lanexa, Virginia

On October 28, 1939 two juvenile specimens of *Natrix rigida* were found at the margin of a large fresh-water tidal marsh in New Kent County, Virginia. This marsh, located at the junction of Diascond Creek and the Chickahominy River, is approximately two miles from Lanexa. Both specimens were found burrowing in the mud beneath partially buried small logs that were lying in the marsh about four feet from the shore.

Stejneger and Barbour (Check List N. A. Amphibians and Reptiles, fourth edition, 1939, p. 128) give "South Carolina to western Louisiana, excluding peninsular Florida" as the range of *Natrix rigida*. The present record, therefore, extends the known range of this species approximately 350 miles northeastward along the Atlantic Coastal Plain and adds another species to the herpetofauna of Virginia.

Both specimens have been deposited in the Carnegie Museum and M. Graham Netting has supplied the following descriptions of them: CM 18171, juvenile male, scale rows 19-19-17, ventrals 135, caudals 60, supralabials 7, infralabials 10, preoculars 2, postoculars 2 on left and 3 on right side, temporals 1 + 2 on left and 1 + 3 on right side, last ventral divided, anal divided, head-body length 213 mm., and tail length 60 mm. CM 18172, juvenile male, scale rows 19-19-17, ventrals 135, caudals 63, supralabials 7, infralabials 10, a single preocular, postoculars 2, temporals 1 + 2 on left and 1 + 3 on right side, last ventral divided, anal divided, head-body length 181 mm., and tail length 53 mm. Each specimen has a narrow black stripe, about two scales in width, on each side of the median dorsal row of scales; these stripes begin at the posterior margins of the parietals and become invisible on the distal half of the tail. The supralabials are golden yellow; the ventral pattern consists of two longitudinal rows of black spots which meet on the first ventral of the larger specimen and fail to meet in the smaller. The spots are semicircular in shape with their convex sides directed posteriorly, and are located on the anterior half of each ventral in such manner that they are largely overlapped by the edge of the preceding ventral; the spots are greatly flattened on the posterior two-thirds of the body but they fail to meet on the midline of the belly, and they do not form the continuous, straight-edged black stripe seen in some adult *rigida;* two much-broken rows of black spots occur on the caudals.

BOOK REVIEWS

THE RATTLESNAKES, GENERA *SISTRURUS* AND *CROTALUS.* A study in zoogeography and evolution, by Howard K. Gloyd. Special Publication No. 4. The Chicago Academy of Sciences, 1940. vii, 266, [iv] pages, 31 plates. $2.50.

When, in the Nineties of the last century, Cope was preparing his review of the rattlesnakes for his *Crocodilians, lizards, and snakes of North America,* and Stejneger was drawing up his admirable *Poisonous snakes of North America,* these two leading herpetologists of the country were scarcely on speaking terms. It is not the least notable feature of the renewed studies on rattlesnakes in our day that they are being carried on in cordial coöperation by two of our leading herpetologists. That this spirit of friendliness and mutual aid pervades modern herpetological studies perhaps affords the most notable contrast between the herpetology of our era and that of a past generation; the present work is one of the monuments to this coöperative spirit.

The principal modern studies on rattlesnakes are those by L. M. Klauber, of San Diego, California, and Howard K. Gloyd, Director of the Chicago Academy of Sciences. Their division of this field of study has lain in part in a special treatment of the difficult western groups by Mr. Klauber, while Dr. Gloyd has dealt in greater detail with the eastern, and certain of the Mexican forms. They have, however, interchanged data, notes, and ideas, and it is thus no accident that both the present work and Klauber's *A key to the rattlesnakes with summary of characteristics* (1936) are equally models of taxonomic workmanship.

The volume under review deals intensively with the genus *Sistrurus,* with the *triseriatus* and *durissus* groups of the genus *Crotalus,* and with some of the more isolated species. The species recently discussed in detail by Klauber (especially the *atrox* and *viridis* groups) are happily included in abbreviated treatment, so that the work forms an adequate handbook or reference book for any student who wishes to acquaint himself with the taxonomy of these creatures. It will be disappointing to those who are not forwarned that it does not deal at all with the habits or general biology of the rattlesnakes, on which Dr. Gloyd has a large volume of accumulated notes. This material has been reserved for future treatment.

The work under review includes an interesting historical review of studies on rattlesnakes and a careful, though all too short, general summary, which discusses the phylogeny and zoögeography of the rattlesnakes.

Much significant zoögeographic discussion is also included in the summaries following the sections on *Sistrurus* and the *triseriatus* and *durissus* groups of the genus *Crotalus*. In this connection, the divorce of the strictly geographic data from the ecological is sometimes carried to an undue extreme. In the description of the new form, *Crotalus triseriatus miquihuanus*, for example, the localities of the type and paratypes are stated and mapped, but the altitudes of these localities are not given. The discussion of the remarkable isolated colony of *Crotalus atrox* in Tehuantepec also deals with the geographic range of the species as if it were conceptually distinct from its habitat.

The volume is excellent in form and typography, and for well planned illustration, which includes examples from Dr. Gloyd's own notable series of snake portraits.—*Karl P. Schmidt, Field Museum of Natural History.*

NOMENCLATOR ZOOLOGICUS. Edited by Sheffield Airey Neave. Zoological Society of London. Vol. 1. xiv, 958, 1939. To be completed in four volumes, 8 guineas.

Another attempt at a complete list of all genera. The part at my disposal had no additions to herpetological genera over those listed in the Prussian Academy's Nomenclator. Its main advantages being, then, its reasonable cost, its more convenient format, (although I would prefer more marginal space for annotations), and, I hope, the fact that it will be completed!—*Walter L. Necker*

A FIELD BOOK OF NORTH AMERICAN SNAKES. By Raymond L. Ditmars. Doubleday, Doran & Co. xii, 305 pages, 49 plates, 1939. $3.50

American publishers are waking up to the fact that there *is* a market for reptile books. Within the last three years major publishers have launched six good-sized volumes alone, and at least three more are due to come relatively soon! Let us hope they will be really worthwhile volumes with new ideas rather than a publisher's attempt to keep up with a competitor's book.

The present book of Dr. Ditmars, outside of some general information on snakes, is divided into three sections each of which deals with a certain territory and contains a separate key to and descriptions of the species found in it. This is done for "convenience." Although it might be convenient to have separate keys to three geographic areas, they should include *all* species—even those which only barely enter the region. The

descriptions of species, however, could all well be placed after the keys with *page*, not chapter, references, both for greater convenience and a saving of space in repetitions.

Photographs of short strips of snakes showing heads, with dorsal, ventral, and lateral patterns, have excellent possibilities, as some of Dr. Ditmars' photographs show. The idea should be followed up in other North American books, as it has been in foreign ones.

I am looking forward to reviewing a really excellent guide to North American reptiles. Several are needed. (1) A real *field book*, which is small enough to fit in a pocket and concise enough to be useful without excessive attempts at "popularity" which lead almost invariably to mediocrity. (2) A comprehensive, really extensive "monograph," with *new* and excellent photographs and emphasis on habits of our native animals; a book to take the place of Cope's North American work—only better. (3) A good juvenile book for pre-grade and lower grade children to give them accurate information and rid them of fear and falacious ideas. These three books would fill our lay needs---and would sell. None now on the market fill the above needs; I hope some publisher will find appropriate authors for them.---*Walter L. Necker*

THE TETRAPOD REPTILES OF CEYLON. Vol. 1. Testudinates and crocodilians. By P. E. P. Deraniyagala. Colombo Museum, Ceylon or Dulau & Co., London. 1939. 412 pages, 137 figs., 24 plates. 15 sh.

A most comprehensive volume treating largely with the development and habits of the following Ceylon species:

Dermochelys coriacea Linnaeus
Lepidochelys olivacea Eschscholtz
Caretta gigas Deraniyagala
Eretmochelys imbricata Linnaeus
Chelonia mydas Linnaeus
Melanochelys trijuga thermalis Lesson
Melanochelys trijuga parkeri Deraniyagala
Testudo (Geochelone) elegans Schoepff
Lissemys punctata granosa Schoepff
Crocodylus palustris kimbula Deraniyagala
Oopholis porosus Schneider

Although much of the material has been published previously in the Ceylon Journal of Science, it is gratifying to have another comprehensive regional work easily available in book form. This volume is especially noteworthy in that it is profusely illustrated and emphasizes the habits of the animals considered.---*Walter L. Necker*